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Department of Defense  
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

# DoD use of Domestically-Produced Alternative Fuels and Alternative Fuel Vehicles

## Briefing Requested by Public Law 111-383

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13. SUPPLEMENTARY NOTES <b>The jointly produced Committee Print of the House Armed Services Committee accompanying the National Defense Authorization Act of 2011, Page 415, Public Law 111-383, requested a briefing on the use of domestically-produced alternative fuels or technologies by vehicles of the Department of Defense (http://www.gpo.gov/fdsys/pkg/CPRT-111HPRT63160/pdf/CPRT-111HPRT63160.pdf). The enclosed briefing was presented to the Committees on Armed Services of the Senate and House of Representatives on April 10, 2014, in the Russell Senate Office Building, Washington, DC., The original document contains color images.</b>		
14. ABSTRACT <b>The enclosed briefing to the Committees includes information on the status of: (1) use and potential use of domestically-produced alternative fuels including but not limited to, natural gas based fuels and biodiesel, in DoD vehicles; (2) current and projected actions by the DoD to increase the use of alternative fuels in vehicles; (3) a description and assessment of current and anticipated commercial availability and demand for alternative fuels including cost; (4) a description of the infrastructure and associated costs required to store and distribute alternative fuels on military installations in the United States that could be adapted for use by alternative fuels; (5) a list and status of the current tactical, non-tactical, and combat vehicle programs that are pursuing either hybrid or electric technologies, or advances to accept alternative fuels; (6) a list of research and development programs and funding investments for operational energy; and (7) any recommendations for legislative or administrative action to ensure that the DoD meets goals for the use of alternative fuels and vehicles.</b>		

15. SUBJECT TERMS <b>alternative fuel infrastructure, electric vehicles, biofuels, ethanol, biodiesel, drop-in, synthetic fuel, vehicle-to-grid, compressed natural gas (CNG), government fleet, Congress</b>					
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## *Legislative Request*

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**The jointly produced Committee Print of the House Armed Services Committee accompanying the National Defense Authorization Act of 2011, Page 415, Public Law 111-383, requested a briefing on the use of domestically-produced alternative fuels or technologies by vehicles of the Department of Defense.**



## *Legislative Language (with numbering added)*

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The Committees on Armed Services of the Senate and House of Representatives note that while the Department of Defense is making advances in alternative fuels for vehicles and hybrid electric technologies, concerns remain that a strategic-level plan and coordinated approach are lacking and proliferation of technology is not as robust across the fleet as it could be. Not later than 45 days after the date of the enactment of this Act, the Under Secretary of Defense for Acquisition, Technology, and Logistics jointly with the Director of the Defense Logistics Agency, shall brief the Committees on Armed Services of the Senate and House of Representatives regarding the status of:

- (1) use and potential use of domestically-produced alternative fuels including but not limited to, natural gas based fuels and biodiesel, in DoD vehicles;
- (2) current and projected actions by the DoD to increase the use of alternative fuels in vehicles;
- (3) a description and assessment of current and anticipated commercial availability and demand for alternative fuels including cost;
- (4) a description of the infrastructure and associated costs required to store and distribute alternative fuels on military installations in the United States that could be adapted for use by alternative fuels;
- (5) a list and status of the current tactical, non-tactical, and combat vehicle programs that are pursuing either hybrid or electric technologies, or advances to accept alternative fuels;
- (6) a list of research and development programs and funding investments for operational energy; and
- (7) any recommendations for legislative or administrative action to ensure that the DoD meets goals for the use of alternative fuels and vehicles.



## *(1) DoD (Non-tactical) Use of Alternative Fuels*

**Information requested:** *“use and potential use of domestically-produced alternative fuels including but not limited to, natural gas based fuels and biodiesel, in DoD vehicles”*

### **2013 Alternative Fuel Sales to the Military Services and Defense Agencies:**

<b>Alternative Fuel</b>	<b>Expenditures (thousand USD)</b>
Bio-diesel	\$2,810
Compressed Natural Gas (CNG)	\$125
E-85	\$21,927
Electric	\$171
Hydrogen	\$3
Liquefied Natural Gas (LNG)	\$4
Liquefied Petroleum Gas (LPG)	\$14
<b>Total</b>	<b>\$25,053</b>

**Note: Volumes remain very small relative to traditional fuel consumption (i.e., >4 billion gallons).**

*Data source: GSA's FAST Data Center (accessed Feb 2014)*

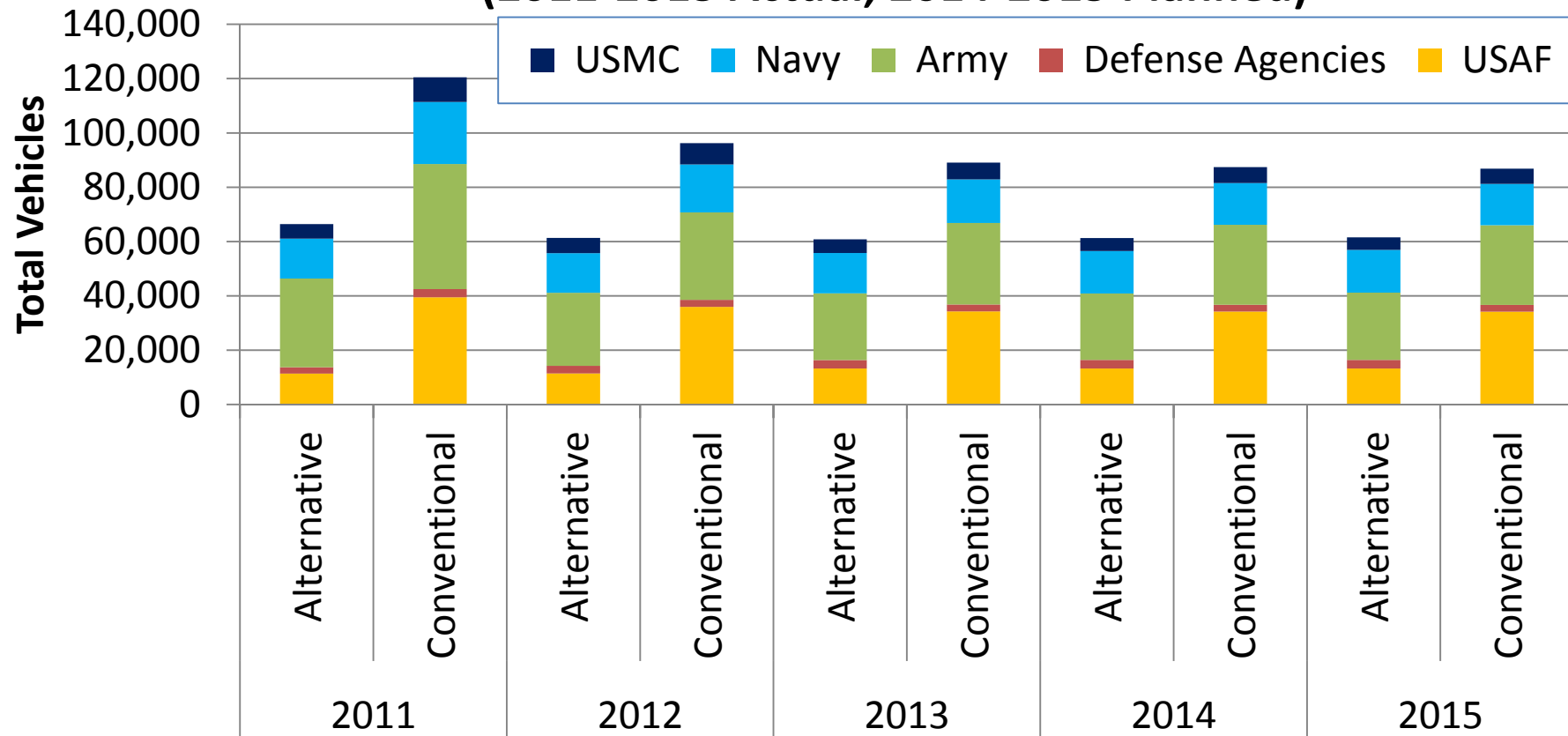
*Note: Data source compiles alternative fuel consumption from GSA leased vehicles that re-fuel on government facilities. This table does not include sales of alternative fuels for RDT&E purposes.*



# *(1) Inventory of (Non-tactical) Vehicles with Potential to Use Alternative Fuels*

**Information requested: “use and potential use of domestically-produced alternative fuels including but not limited to, natural gas based fuels and biodiesel, in DoD vehicles”**

**DoD Fleet Vehicle Inventory  
(2011-2013 Actual, 2014-2015 Planned)**



Data source: GSA's FAST Data Center (accessed Feb 2014)



## *(2) Actions to Increase Alternative Fuel Vehicles*

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**Information requested:** *“current and projected actions by the DoD to increase the use of alternative fuels in vehicles”*

**❑ Most increases in DoD alternative fuel usage in non-tactical vehicles will result from compliance with national policies, e.g.,:**

- Federal Fleet Performance Memorandum (2011): By Dec 31, 2015, all new federal vehicle acquisitions shall be alternative fuel vehicles (AFVs), other than exempt vehicles (e.g., emergency response, law enforcement, and military tactical vehicles).
- 10 USC 2922g (2009): DoD shall apply a preference for the lease or procurement of electric and hybrid vehicles, if ‘comparable’ in total operating cost to conventional vehicles.
- Section 400FF of the Energy Policy and Conservation Act, as amended (42 U.S.C. § 6374e), requires Federal agencies to achieve a 20% reduction in non-tactical fleet vehicle petroleum consumption by FY 2015 (vs. FY 2005 baseline).
- Executive Order 13514 (2009): Federal agencies shall achieve 30% reduction in (non-tactical) vehicle fleet petroleum use by FY 2020 (vs. FY 2005 baseline).
- Executive Order 13423 (2007): Federal fleets shall use plug-in hybrid electric vehicles (PHEVs), when available at lifecycle costs ‘reasonably comparable’ to conventional vehicles.
- Energy Independence and Security Act (2007): Federal agencies shall increase alternative fuel consumption by at least 10% by 2015 (vs. 2005 baseline).





## *(2) Actions to Increase Alternative Fuel Use*

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Information requested: *“current and projected actions by the DoD to increase the use of alternative fuels in vehicles”*

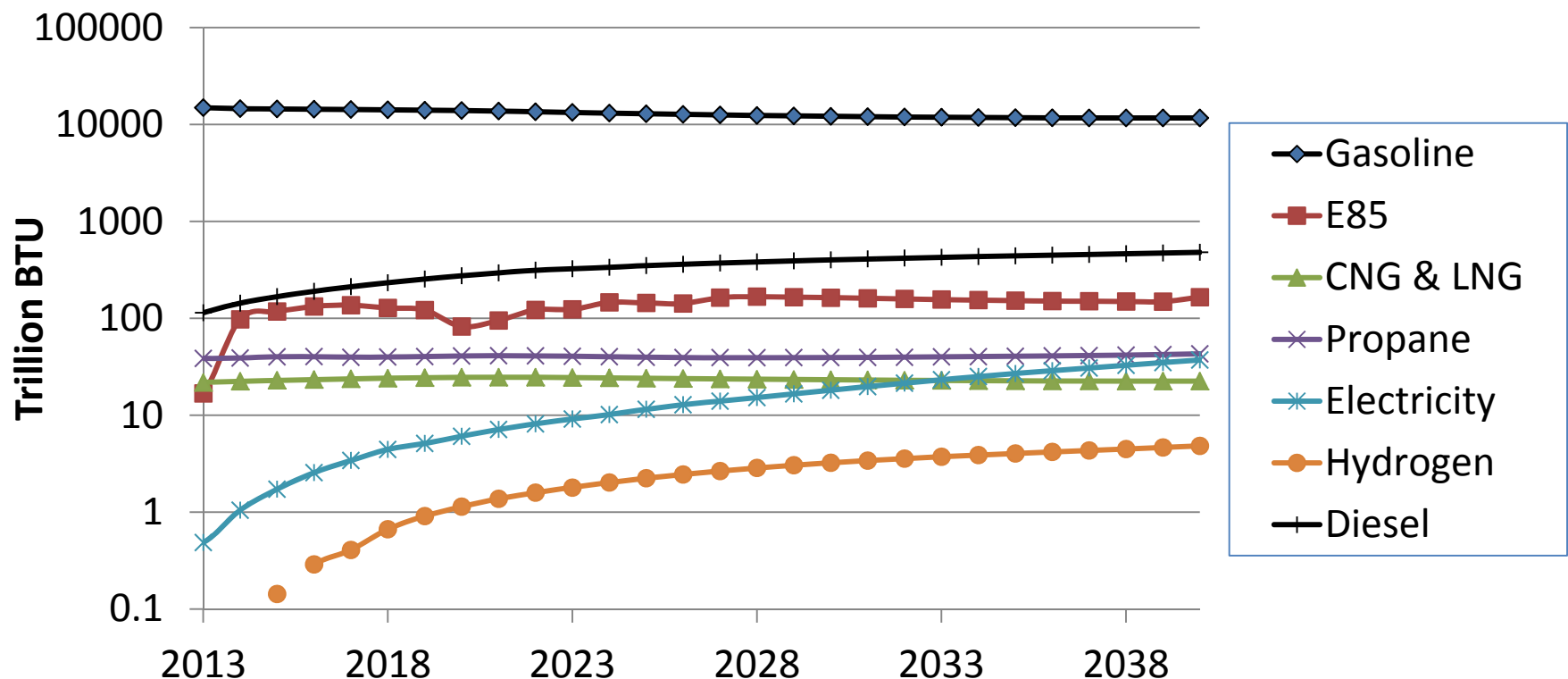
- ❑ **The Air Force and Navy have announced goals to increase alternative fuel consumption (in vehicles as well as ships, planes, and other equipment), when alternative fuels are cost-competitive with petroleum.**
  - **Air Force:** Increase use of cost-competitive drop-in alternative aviation fuel blends for non-contingency operations to 50% of total consumption by 2025. (USAF Energy Strategic Plan, March 2013)
  - **Navy:** Increase alternative energy use DON-wide. By 2020, 50% of total DON energy consumption will come from alternative sources. (U.S. Navy Strategy for Renewable Energy, October 2012)



### (3) Availability and Demand for Alternative Fuels

**Information requested: “a description and assessment of current and anticipated commercial availability and demand for alternative fuels including cost”**

- ❑ Note: This request is best answered by the U.S. Department of Energy.
- ❑ Total U.S. annual light-duty vehicle transportation fuel demand is expected to drop approximately 18% from 2013 through 2040 under the EIA’s Annual Energy Outlook 2013 reference case scenario.



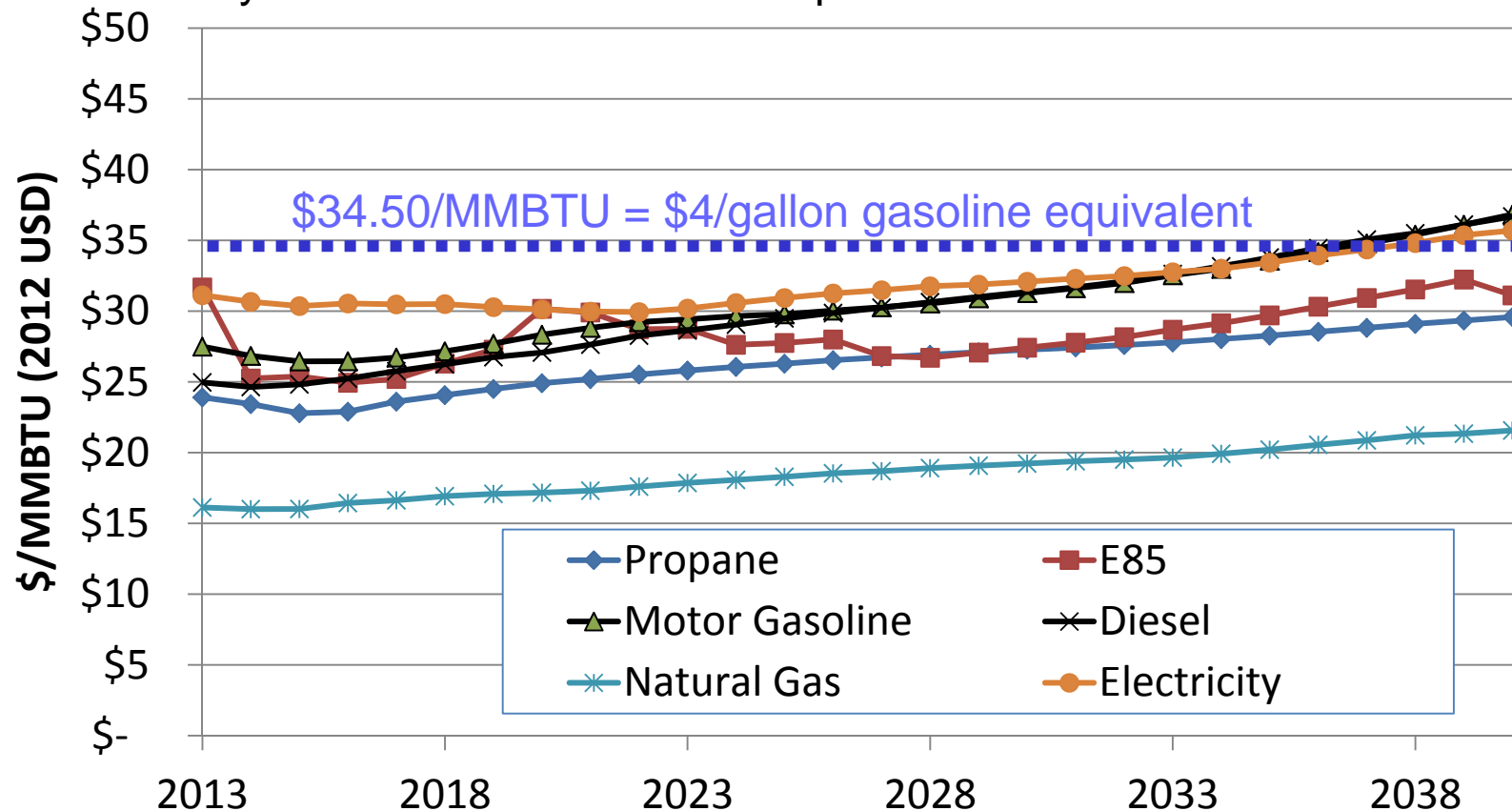
Source: AEO2013 Reference Case, as presented in the US Energy Information Administration (EIA) [Annual Energy Outlook 2014 Early Release](#).



### (3) Cost of Alternative Fuels

**Information requested:** “a description and assessment of current and anticipated commercial availability and demand for alternative fuels including cost”

- ❑ Note: This request is best answered by the U.S. Department of Energy.
- ❑ As the efficiency of vehicle technologies varies by fuel, fuel costs do not necessarily reflect differences in costs per vehicle-mile traveled.



Source: AEO2013 Reference Case, as presented in the US Energy Information Administration (EIA) [Annual Energy Outlook 2014 Early Release](#).



## (4) Description of Alternative Fuel Storage and Distribution Infrastructure

**Information requested:** “a description of the infrastructure and associated costs required to store and distribute alternative fuels on military installations in the United States that could be adapted for use by alternative fuels”

- ❑ Infrastructure requirements to store and distribute alternative fuels on military installations are similar to the requirements of the commercial sector (as described by the U.S. Department of Energy).

Color Key:

Existing Components

New Production

New Delivery

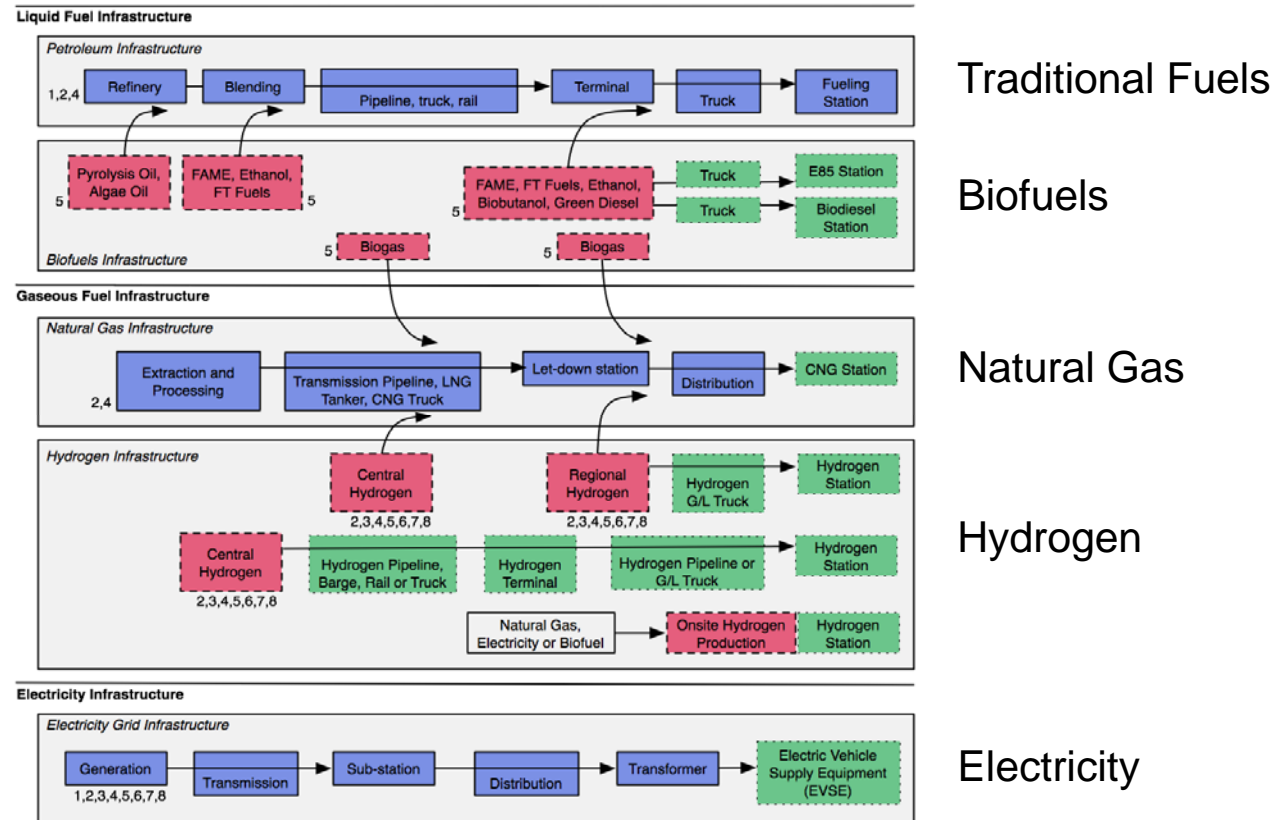


Figure 2.1. Existing and new infrastructure components for producing and delivering liquid fuels, gaseous fuels, and electricity, from NREL report under contract DC-A36-08GO28308 (Source: Derived from Bunting et al. 2010) 10



## ***(4) Capital Costs Required to Install Alternative Fuel Refueling Stations***

**Information requested:** “ a description of the infrastructure and associated costs required to store and distribute alternative fuels on military installations in the United States that could be adapted for use by alternative fuels”

❑ Note: This request is best answered by the US Department of Energy.

Retail Capital Costs per Mile (2005\$)	Gsln/Dsl Stations	CNG Stations	Hydrogen Stations	EVSE for PHEVs	EVSE for BEVs
<b>2020</b>					
Capital cost per station (\$M/stn)	\$0.73	\$1.43	\$2.05		
Average station output (1000 gge/mo)	95	45	19.75		
Capital cost per charger (\$)				\$1,530	\$2,153
Average output per charger (gge/yr)				158.6	181.4
Capital cost per new capacity (\$/gge/yr)	\$0.64	\$2.64	\$8.65	\$9.65	\$11.87
Average vehicle fuel economy (mpgge)	30	30	65	80	120
Capital cost per 100 miles (\$/100mi)	\$2.14	\$8.80	\$13.31	\$12.06	\$9.89
Replacement cost per year (\$/gge)	\$0.04	\$0.18	\$0.58	\$0.64	\$0.79

**Table 4.11. Summary of Nominal Retail Capital Costs for Liquid, Gaseous, and Electric Charging Outlets**, from NREL report under contract DC-A36-08GO28308  
(Source: Melaina and Penev 2012)

CNG: Compressed Natural Gas  
 EVSE: Electric Vehicle Supply Equipment  
 PHEV: Plug-in Hybrid Electric Vehicle  
 BEV: Battery Electric Vehicle



## ***(5) Non-tactical Hybrid, Electric, and Alternative Fuel Vehicle Programs***

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**Information requested:** “a list and status of the current tactical, non-tactical, and combat vehicle programs that are pursuing either hybrid or electric technologies, or advances to accept alternative fuels”

### **❑ US Navy**

- The Navy contracted for the development of 20 AFV infrastructure sites in FY 2013.
  - These sites include E85, solar carport electric vehicle charging stations, and standalone electric vehicle charging stations.
  - Construction on four of the sites is complete. The remaining sites will be completed by the end of CY 2014.
- In FY 2013, the Navy purchased 107 low-speed electric vehicles (LSEVs) to replace full-size vehicles. GSA has recently announced phase two of this project and the Navy will receive additional full-size EVs.



## ***(5) Non-tactical Hybrid, Electric, and Alternative Fuel Vehicle Programs***

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**Information requested:** “a list and status of the current tactical, non-tactical, and combat vehicle programs that are pursuing either hybrid or electric technologies, or advances to accept alternative fuels”

### **❑ Air Force: Plug-in Electric Vehicle (PEV) Programs**

- The Air Force is the Executive Agent for DoD for the DoD PEV Vehicle-to-Grid (V2G) demonstration.
- FY 2013: Site construction complete for Los Angeles Air Force Base, Joint Base (JB) McGuire-Dix-Lakehurst\*, JB Andrews, and Fort Hood.
  - LA AFB to be the first federal facility to have an all-electric fleet.
- See next chart for more details.

*\*Correction since April 10 briefing: initial slides erroneously listed Fort MacArthur instead of JB MDL.*





## (5) *Vehicle-to-Grid (V2G) Hybrid & Electric Vehicle Demonstration Project, Non-tactical*



**Project will demonstrate the feasibility of reducing the cost of EVs to parity in comparison with alternatively fueled vehicles in DoD's non-tactical vehicle fleets**

**❑ Demonstration is being conducted at four DoD Installations:**

- Los Angeles Air Force Base, CA
- Fort Hood, TX
- Joint Base Andrews, MD
- Joint Base McGuire-Dix-Lakehurst, NJ

**Concept Potentially *Exportable* to Multiple DoD and Other Federal Installations**

**❑ V2G-enabled EVs and hybrids are enabled to participate in Grid Transmission Regulation**

- V2G-enabled vehicles enhance installation-level grid security
- Vehicles additionally earn revenues when tethered to the grid
  - Potential for vehicles to earn V2G tariff is expected to defray total acquisition and operational cost of V2G-enabled vehicles to cost parity with conventional alternatives.
  - Net operational cost of V2G-enabled vehicles can be less than alternatively fueled vehicles
- V2G-enabled vehicles can provide mobile power for local applications, replacing generators

**Simplified View of How V2G Works**



**Electrical Infrastructure**



**Bi-Directional Charging Station**



**Dollars provided by DoD R&D, Air Force, Army, and State of California**

**Electric Vehicles (EVs)**





## *TACTICAL VEHICLE AND FUEL INITIATIVES*

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- ☐ **Tactical vehicles are exempt from Federal mandates to increase alternative fuel consumption.**
- ☐ **DoD's support of initiatives to pursue "either hybrid or electric technologies, or advances to accept alternative fuels" for tactical vehicles is based on ability to enhance military capabilities.**
- ☐ **Success of these initiatives, which reduce fuel consumption and/or enable increased alternative fuel consumption, may promote benefits to broader national energy or environmental goals.**



## ***(5) Tactical and Non-tactical Hybrid, Electric, and Alternative Fuel Vehicle Programs***

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**Information requested:** “a list and status of the current tactical, non-tactical, and combat vehicle programs that are pursuing either hybrid or electric technologies, or advances to accept alternative fuels”

### **❑ US Army: Combat Vehicle & Automotive Technologies Programs**

- Dual Use Technologies (\$11M FY 14, \$58.2M FY 15-19): Ground vehicle applied research in ground vehicle technologies with both military and commercial applications such as renewable energy technologies, electrical power management between vehicles and the grid, alternative fuels, and advanced vehicle network
- National Automotive Center (NAC) Program - Power, Energy and Mobility (\$4M FY 14, \$22M FY 15-19): Ground vehicle applied research in dual use power, energy, and mobility technologies focusing on light weight composite materials, electrification of engine accessories, alternative fuels, hybrid vehicle architectures, and compact electrical power genera
- Alternative Fuels & Petroleum, Oil & Lubricants (\$3M FY 14, \$10M FY 15-19): Ground vehicle alternative fuels and petroleum, oil & lubricants advanced technology development.

Source: [SNaP](#) data submissions from the Services, as of December 2013.



## *(5) Advances to Accept Alternative Fuels*

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**Information requested:** “a list and status of the current tactical, non-tactical, and combat vehicle programs that are pursuing either hybrid or electric technologies, or advances to accept alternative fuels”

- ❑ DoD is preparing to use drop-in alternative jet and diesel fuels.
  - **DLA’s** Energy Readiness Program (\$4.0M FY 13, \$13.3M FY 14-18), supports Alternate Energy Development (among other initiatives) to include test and certification to support the addition of synthetic and alternative fuels to mobility fuel specifications.
  - **Army’s** Tank Automotive Research, Development and Engineering Center (TARDEC) (\$1.5M FY 14 and \$6.6M FY 15-19) is assessing the impact of using emerging alternative fuels in ground platforms, which includes tactical/combat vehicles and other deployable assets.
  - **Navy’s** Alternative Fuels Program (\$7.6M FY 14, \$64M FY 15-19) supports testing to determine the effects of changes in fuel chemistry and properties on the performance and reliability of Naval ship, aircraft, and fuel distribution systems.
  - **USAF’s** Aerospace Propulsion Program is investing in evaluation of advanced fuels (\$5.3M FY 14, \$26.7 FY 15-19) and demonstration of fuels (\$2.3M FY 14, \$11.6 FY 15-19) for performance, environmental impact and system operations.

Source: [SNaP](#) data submissions, as of December 2013.



## ***(5) Status of Efforts to Qualify Alternative Fuels for Inclusion in Military Fuel Specifications***

**Information requested:** “a list and status of the current tactical, non-tactical, and combat vehicle programs that are pursuing either hybrid or electric technologies, or advances to accept alternative fuels”

	Max. Blend	ASTM Jet	JP-8 (Jet)*	JP-5 (Jet)	F-76 (Diesel)
HEFA	50%	✓	✓	✓	Expected 2014
F-T	50%	✓	✓	✓	Expected 2014
ATJ	50%	Expected 2014	-	Expected 2015	-
DSH	10%	Expected 2014	Tri-Service Lab testing of DSH (diesel and jet) expected completion 2014.		
HDC	20%	Expected 2014-2015	Tri-Service Lab testing of HDC (diesel and jet) expected completion 2014.		
CH	100%	Expected 2014-2016	Tri-Service Lab testing of CH expected completion 2015.		

HR/HEFA

F-T

ATJ

DSH

HDCD, HDCJ

CH

Hydroprocessed Renewable/ Hydroprocessed Esters and Fatty Acids

Fischer-Tropsch

Alcohol-to-Jet

Direct Sugar to Hydrocarbon

Hydroprocessed Depolymerized Cellulosic Diesel, Jet

Catalytic Hydrothermolysis (jet)

\* Additional note (not in April 10 briefing): See section 3.1.1 of [MIL-DTL-83133H/AMD2](#) for status of Services' synthetic fuel certification efforts.



## *(6) Major Operational Energy Initiatives*

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Information requested: “a list of research and development programs and funding investments for operational energy”

❑ **ASD(OEPP) FY 2015 Operational Energy Certification Report (DRAFT)**

REDACTED.  
See OEPP website for  
completed reports.



## *(7) Legislative Recommendations*

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**Information requested: “any recommendations for legislative or administrative action to ensure that the DoD meets goals for the use of alternative fuels and vehicles”**

- ☐ We support fuel and vehicle policies that ensure the greatest capability of our warfighters.
  - Non-tactical fuels and vehicles: DoD is driven by the need to comply with Federal laws and policies.
  - Tactical fuels and vehicles: DoD is interested in alternative fuels that are equal or better than traditional fuels in cost, capability, compatibility, and emissions.
- ☐ We have no legislative or administrative recommendations at this time.



# *Acknowledgements*

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- ❑ **Acquisitions Resources Analysis (ARA), Property & Equipment Policy**
- ❑ **Installations and Environment (DUSD(I&E))**
- ❑ **Defense Logistics Agency Energy (DLA Energy)**
- ❑ **Non-Tactical Vehicle Fleet Managers from All Services**
- ❑ **Operational Fuels and Vehicles Contacts:**
  - Army
    - Tank Automotive Research, Development and Engineering Center (TARDEC)
    - Aviation and Missile Research Development and Engineering Center (AMRDEC)
    - Office of the Assistant Chief of Staff for Installation Management (OACSIM)
    - Army Petroleum Center (APC)
  - Marine Corps Expeditionary Energy Office (E2O)
  - Air Force Research Laboratory (AFRL)
  - Air Force Installations, Environment & Logistics (SAF/IE)
  - Navy Energy, Installations, & Environment (OASN(EI&E))
- ❑ **US Department of Energy**
  - National Renewable Energy Laboratory (NREL)
  - Office of Energy Efficiency and Renewable Energy (EERE)



# *BACKUPS*

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## (1) Potential use of alternative fuels in vehicles

***“use and potential use of domestically-produced alternative fuels including but not limited to, natural gas based fuels and biodiesel, in DoD vehicles”***

- 2013 DoD Vehicle Inventory by Type and Service:

	Def. Agencies	USAF	Army	Navy	USMC	Grand Total
<b>Alternative</b>						
CNG BI	4	152	27	173	40	396
CNG DE		24	1	34	92	151
DSL HY			79	15	11	105
E85 FF	2,727	11,745	22,811	13,206	4,226	54,715
ELE DE	109		814	1,332	807	3,062
GAS AF	1		97	148	86	332
GAS HY	310	1,271	2,895	919	407	5,802
GAS PH	13	77	94	10	10	204
HYD DE					5	5
LNG BI			1			1
LPG BI			47			47
LPG DE				1		1
<b>Conventional</b>						
DSL DE	867	16,174	16,028	5,698	2,508	41,275
GAS DE	2,143	18,107	22,834	17,822	4,613	65,519
<b>Grand Total</b>	<b>6,174</b>	<b>47,550</b>	<b>65,728</b>	<b>39,358</b>	<b>12,805</b>	<b>171,615</b>



## (1) Potential use of alternative fuels in vehicles

***“use and potential use of domestically-produced alternative fuels including but not limited to, natural gas based fuels and biodiesel, in DoD vehicles”***

	Army	Navy	USMC	USAF	Def. Agencies	TOTAL
<b>Conventional Vehicles</b>						
2011	46,092	22,813	9,096	39,504	2,975	<b>120,480</b>
2012	32,193	17,647	7,847	35,960	2,581	<b>96,228</b>
2013	30,018	16,080	6,149	34,281	2,535	<b>89,063</b>
2014	29,451	15,373	5,882	34,226	2,492	<b>87,424</b>
2015	29,364	15,199	5,607	34,209	2,457	<b>86,836</b>
<b>Alternative Vehicles</b>						
2011	32,680	14,705	5,351	11,393	2,317	<b>66,446</b>
2012	26,905	14,570	5,605	11,424	2,832	<b>61,336</b>
2013	24,547	14,841	5,016	13,269	3,126	<b>60,799</b>
2014	24,501	15,613	4,799	13,268	3,134	<b>61,315</b>
2015	24,762	15,774	4,608	13,262	3,154	<b>61,560</b>
<b>Grand Total</b>	<b>300,513</b>	<b>162,615</b>	<b>59,960</b>	<b>240,796</b>	<b>27,603</b>	

Data source: FAST

**DATA USED FOR FIGURE  
IN STACKED BAR CHART (SLIDE 5)**